

Incidence and Risk Factors of Ipsilateral Shoulder Pain in Patients Undergoing Thoracic Surgeries

Raghu SP¹, Krunal Ramteke², Peram Srividya³

¹Associate Professor, Dept. of Anesthesiology, Basaveshwara Medical College and Hospital, Chitradurga, Karnataka

²Assistant professor, Dept. of Anaesthesiology, Vedantaa Institute of Medical Sciences, Dahanu, Palghar (Maharashtra)

³Assistant professor, Dept. of Anesthesiology, Basaveshwara Medical College and Hospital, Chitradurga, Karnataka

Received: 25-05-2024 / Revised: 23-06-2024 / Accepted: 25-07-2024

Corresponding Author: Dr. Krunal Ramteke

Conflict of interest: Nil

Abstract:

Introduction: Thoracic surgeries pose significant challenges due to high surgical trauma and associated ipsilateral shoulder pain (ISP), affecting 21–97% of patients. ISP impairs recovery, increases hospital stay, and is influenced by surgical and patient-specific factors. Effective management requires a multimodal approach encompassing preoperative screening, optimized intraoperative techniques, and combined pharmacological and non-pharmacological postoperative strategies.

Aims and Objective: To analyze various factors and their association with ISP in patients undergoing Thoracic Surgeries.

Method: This prospective observational study was conducted at hospital, from February 2023 to January 2024, involving 120 patients undergoing thoracic surgeries. Patients were assessed for ipsilateral shoulder pain (ISP) using the Numerical Rating Scale (NRS) and Visual Analogue Scale (VAS). Inclusion criteria included patients aged 20-65 with consent; exclusion criteria included pre-existing shoulder pain. Statistical analyses utilized Shapiro-Wilk, chi-square, and regression models, with $P < 0.05$ considered significant.

Result: The baseline characteristics reveal no significant gender differences in ipsilateral shoulder pain (ISP) occurrence (P -values: 0.0855 for males, 0.0954 for females). ISP patients were older (mean age: 55.48 ± 13.56 years) and had a higher BMI (35.42 ± 5.55). Thoracotomy was more common among ISP patients ($P=0.095$), with epidural analgesia ($P=0.003$) and lower epidural block levels ($P=0.004$) showing significant associations. ISP predominantly caused dull aching pain, particularly in the anterior shoulder region

Conclusion: The study concluded that there was 56.67% of patients with ipsilateral shoulder pain (ISP) and it is most commonly associated with dull aching and is frequently localized to the anterior and superior parts of the shoulder. ISP is more prevalent in older patients with higher BMI and is significantly associated with epidural analgesia and thoracotomy procedures.

Keywords: Thoracotomy, Ipsilateral Shoulder Pain, Shoulder Pain, Thoracic Surgery.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Thoracic surgeries are associated with a high degree of surgical trauma and thereby impart challenges to post-thoracotomy pain and its management requires a multimodal approach. ISP is a common complication, with reported incidence rates that vary widely between 21% and 97% [1]. These discrepancies reflect the multifactorial nature of ISP and highlight the need for effective prevention and management strategies. ISP exacerbates the negative effects of surgery on postoperative recovery by impairing respiration, increasing pain during mobilization, hindering early physical therapy (PT) participation, prolonging hospital length of stay (LOS), and negatively impacting overall recovery after surgery [2, 3].

The proposed etiology for ISP includes- first, the musculoskeletal theory suggests that ISP is a result of strain and tension on the shoulder joint from intraoperative positioning and manipulation[4]. Second, ISP is referred pain which originates from the diaphragm or phrenic nerve that can be irritated during surgery. This may be true since thoracic epidural analgesia, known to provide effective analgesia for incisional pain, does not provide any relief of ISP indicating that it may not be mediated via the same pain pathway [5, 6].

The risk factors of ISP can be broadly divided into surgical factors and patient characteristics. Surgical factors include the type and length of the surgery,

as a longer and more extensive procedure will place the shoulder at risk for a longer period of time, as well as greater retraction, which places strain on the shoulder, increasing the likelihood of developing an ISP. The surgical approach and techniques utilized can also play a role in determining if an ISP occurs, as some procedures may cause more trauma and inflammation [7, 8].

Patient-related factors also contribute to the onset of ISP- age, gender, and pre-existing shoulder conditions have been shown as significant predictors. Older patients are more prone to ISP; this may be related to decreased tissue resiliency as well as increased prevalence of musculoskeletal pathology in older patients. Gender differences in pain perception and physiologic responses may also influence the incidence of ISP. Knowledge of these predisposing factors can help develop strategies for prevention and allow individualization of pain management for patients [5, 9].

ISP is a physical and psychological burden on the patients with an impact on the post thoracotomy quality of life [10]. ISP management thus, requires concerted efforts, inclusive of all disciplines starting from preoperative evaluation, intraoperative modalities and the postoperative care [11–13].

Preoperative screening can identify those who are more at risk allowing early management and include prehabilitation of the patient prior to surgery, optimization of any pre-existing shoulder problems and educating patients regarding ISP and its management [5, 14]. Intraoperative measures like minimizing shoulder strain by positioning patients appropriately and minimizing retraction time during surgery, is essential in reducing the development of ISP [15,16]. Surgeons and anesthesiologists should ensure that the surgical approach and techniques employed cause minimal tissue disruption and inflammation. Intraoperative vigilance of patient positioning and protective padding further minimize ISP [17]. Postoperative management aiming multimodal analgesia i.e, combination of pharmacological and nonpharmacological interventions can target different pain mechanisms activated by ISP [18]. Among the pharmacological treatment options, nonsteroidal anti-inflammatory drugs, opioids, and muscle relaxants are the common choices for postoperative management [19]. However, the varying efficacy of these drugs and their potential adverse effects necessitates new postoperative approaches in pain management [16]. The non-pharmacological treatments concentrate on the musculoskeletal aspect of the pain and includes physiotherapy, acupuncture and transcutaneous electrical nerve stimulation (TENS) [13,20]. Physiotherapy is directed on enhancement of shoulder mobility and strength, pain reduction as well as recovery progression while acupuncture and TENS modulates pain signals and accelerates tissue

regeneration [12, 14, 15].

Thoracic epidural analgesia provides excellent control of incisional pain, but consistently fails to provide adequate management of ipsilateral shoulder pain (ISP) observed after thoracotomy. Poorer management of this aspect of post-thoracotomy pain reflects the necessity for better understanding and development of newer modalities for managing the pain that retards recovery and rehabilitation in the aftermath of surgery [5, 16, 21].

Method

Research Design: This is a prospective and observational study among patients those who were underwent surgeries in thoracic and were in severe pain in shoulder. The study was conducted at Hospital, the duration of the study was from February 2023 to January 2024. The study considered 120 patients those who were enrolled for different thoracic surgeries, were enrolled for the study after having both written and verbal consent of the patients along with the ethical community approval needed for the study. Different approaches were there for surgery including standard posterolateral thoracotomy which is also called as Video Assisted Thoracoscopic Surgery (VATS).

The enrolled patients those who have incident open thoracotomy were given thoracic from T5 to T11 epidural catheter and were given before the stage of anaesthesia. Afterwards bupivacaine at 0.1% along with fentanyl about 2ug/ml were given between the operative measures. Paracetamol IV was intravenously administered to all of them during post-operative process. Also NSAIDs were given orally as analgesia after surgery. Other analgesics include fentanyl which was pumped using patient controlled analgesia pump (PCA), antidepressants orally were administered on the basis of the level of pain.

Numerical rating scale (NRS) which is 11 point scale for assessing the shoulder and thoracic pain at rest condition also during the activity. 0 level shows no pain while highest scale point 10 shows unbearable pain. Another scale for measurement of pain includes visual analogue scale where minimum 0 level shows no pain while maximum level 10 shows unbearable or severe pain. Mild pain was represented by level 1 to 3 and 4 to 6 shows moderate level of pain. Above 7 indicates extreme or severe pain level. The assessment was done at different time intervals during 1, 6 and 12 hour time interval after surgery. Different parameters and data was measured and recorded which includes age, gender of the patients along with body mass index (BMI). Physical status of the patient were classified according to ASA were included. Apart from these, surgery type and side with proper approach and time of surgery along

with positioning were also taken into account. The variance in the regional anaesthesia and the placement of catheter in the patients were also determined.

Inclusion Criteria

The criteria based on which patients were included from the study were

- Patients those who were diagnosed with incident thoracic surgeries were only included for the study
- Patients from age 20 and up to 65 years were allowed for the study.
- Patients with self -consent and ethical approval were included for study.

Exclusion Criteria

The criteria based on which patients were excluded from the study were

- Patients those who were below 20 years age and above 65 years of age were not included.
- Patients diagnosed with severe pain in shoulder before surgery were excluded.
- Patients having analgesics for many weeks before surgery were not allowed for study.
- Patients having abnormality in rating their pain according to NRS scale were excluded.
- Patients with multiple comorbid conditions were not allowed for the study.

Statistical Analysis

Statistics were used for measuring and comparing different data. Mean or median value was used for representation of continuous data while counts or percentage (%) was used for representation of categorical data. For checking the variable normalcy, Shapiro-Wilk test was utilised. For understanding how much the variables were distributed, descriptive analysis was used. For associating variables of clinicodemographic along with demographic variables, chi – square test with Pearson’s test was utilised. In that case, fisher’s exact test can also be obtained. Regression model was used for analysis of predictors where as an outcome variable ISP was used. P value was <0.05 for statistical significance.

Result

Table 1 shows the baseline characteristics of the patients presented in Table 1 show that among those with ipsilateral shoulder pain (ISP), 29.17% were males and 27.5% were females. For patients without ISP, 22.5% were males and 20.83% were females. The P-values for gender differences (0.0855 for males and 0.0954 for females) suggest no statistically significant difference between genders in the occurrence of ISP. The mean age of patients with ISP was 55.48±13.56 years, slightly higher than those without ISP (50.55±15.82 years). Regarding Body Mass Index (BMI), patients with ISP had a higher mean BMI of 35.42±5.55 compared to 25.88±2.25 in those without ISP, indicating a notable difference in BMI between the two groups.

Table 1: Baseline characteristics of the patients

| Parameters | Ipsilateral shoulder pain mean ±SD | | P-value |
|--------------|------------------------------------|---------------|-------------|
| | Yes | No | |
| Gender | | | |
| Male | 35 (29.17%) | 27 (22.5%) | 0.0855 |
| Female | 33 (27.5%) | 25 (20.83%) | 0.0954 |
| Age in years | 50.55±15.82 | 55.48±13.56 | 55.64±15.45 |
| BMI | 25.88.12±2.25 | 23.41.36±1.56 | 35.42±5.55 |

Table 2 compares the range of age, BMI, and ASA (American Society of Anesthesiologists) scores between patients with and without ISP. Patients aged 20-30 years were more likely to have ISP (11.67%) than those without (2.5%), but the difference is not statistically significant (P=0.0785). In terms of BMI, the majority of patients with ISP fell into the normal weight category (42.5%), while a similar percentage

(34.17%) was observed in patients without ISP. Underweight, overweight, and obese categories were less represented, with minimal differences between the two groups. The ASA grading shows that patients with ISP were more likely to be in Grade 1 (24.17%) and Grade 2 (25%) compared to those without ISP (12.5% in Grade 1 and 24.17% in Grade 2). However, these differences were not statistically significant (P=0.45).

Table 2: Range of age, BMI and ASA between the patients with ISP and without

| Parameters | ISP | | P value |
|--------------|-------------|------------|---------|
| | Yes | No | |
| Age in years | | | |
| 20-30 | 14 (11.67%) | 3 (2.5%) | 0.0785 |
| 31-40 | 16 (13.33%) | 11 (9.17%) | |

| | | | |
|---------------|-------------|-------------|-------|
| 41-50 | 35 (29.17%) | 31 (25.83%) | |
| 51-60 | 8 (6.67%) | 7 (5.83%) | |
| BMI | | | |
| Under weight | 5 (4.17%) | 1 (0.83%) | 0.967 |
| Normal weight | 51 (42.5%) | 41 (34.17%) | |
| Over weight | 8 (6.67%) | 9 (7.5%) | |
| Obese | 3 (2.5%) | 1 (0.83%) | |
| ASA | | | |
| Grade 1 | 29 (24.17%) | 15 (12.5%) | 0.45 |
| Grade 2 | 30 (25%) | 29 (24.17%) | |
| Grade 3 | 9 (7.5%) | 8 (6.67%) | |

Table 3 examines the surgical approach, side of surgery, regional analgesia, and various time-related factors between patients with and without ISP. This shows the risk factors associated with the pain. Among surgical approaches, thoracotomy was more common in patients with ISP (21.67%) compared to those without (16.67%), although the P-value of 0.095 indicates no significant difference. In terms of the side of surgery, the right side was more frequently involved in patients with ISP (31.67%) compared to those without (20.83%). The type of regional analgesia used showed significant

differences; epidural analgesia was more common in patients with ISP (40%) compared to those without ISP (28.33%), with a significant P-value of 0.003. Additionally, the level of epidural block was mostly below T8 in patients with ISP (39.17%), whereas none of the patients without ISP had no epidural block, with a P-value of 0.004. Finally, the duration of anesthesia, surgery, supine position, and lateral decubitus position showed slight differences between the two groups, though these were not statistically significant.

Table 3: Risk Factors including Range of age, BMI and ASA between the patients with ISP and without

| Approach | | | |
|------------------------------------|---------------|---------------|---------------|
| Transhiatal | 19 (15.83%) | 10 (8.33%) | 0.095 |
| Thoracotomy | 26 (21.67%) | 20 (16.67%) | |
| VATS | 23 (19.17%) | 22 (18.33%) | |
| Side | | | |
| midline | 2 (1.67%) | 14 (11.67%) | 0.35 |
| left | 20 (16.67%) | 12 (10%) | |
| right | 38 (31.67%) | 25 (20.83%) | |
| both | 3 (2.5%) | 1 (0.83%) | |
| Regional analgesia | | | |
| none | 3 (2.5%) | 1 (0.83%) | 0.003 |
| epidural | 48 (40%) | 34 (28.33%) | |
| intercostal | 14 (11.67%) | 15 (12.5%) | |
| paravertebral | 3 (2.5%) | 2 (1.67%) | |
| Epidural block level | | | |
| none | 0 | 25 (20.83%) | 0.004 |
| T5-T6 | 2 (1.67%) | 1 (0.83%) | |
| T6-T8 | 19 (15.83%) | 2 (1.67%) | |
| Below T8 | 47 (39.17%) | 24 (20%) | |
| Anaesthesia time(min) | 365.45±115.89 | 299.56±155.29 | 345.75±152.45 |
| Time of surgery (min) | 295.15±150.76 | 235.51±150.21 | 156.45±120.65 |
| Time of supine position | 182.12±165.12 | 145021±110.25 | 165.85±95.42 |
| Time of lateral decubitus position | 195.12±95.46 | 155.29±95.12 | 168.86±97.45 |

Figure 1 shows the distribution of pain location among patients with ipsilateral shoulder pain (ISP) is varied. The most commonly reported location of pain is the anterior part of the shoulder, affecting 22 patients. This is followed by the superior part of the shoulder, where 16 patients reported pain. The posterior part, lateral third of the clavicle, and

anterior chest wall each had 8 patients reporting pain, while the deltoid region was the least commonly reported location, with 6 patients experiencing pain in this area. This data suggests that ISP most frequently affects the anterior and superior parts of the shoulder.

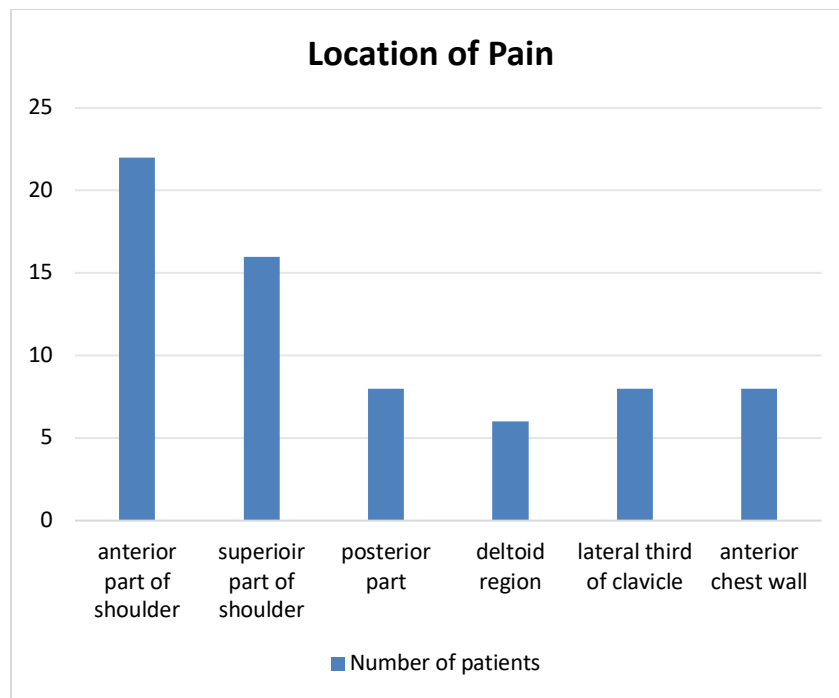


Figure 1: Number of patients with each of the pain location

Figure 2 shows the distribution of the nature of ipsilateral shoulder pain (ISP) among the patients shows that the most common type of pain experienced is "dull aching," which affects 48 patients. This is followed by "stabbing" pain, reported by 15 patients. A smaller number of patients experienced "throbbing" and "burning" pain, with 3 and 2 patients, respectively, indicating that these types of pain are less common among the patients with ISP.

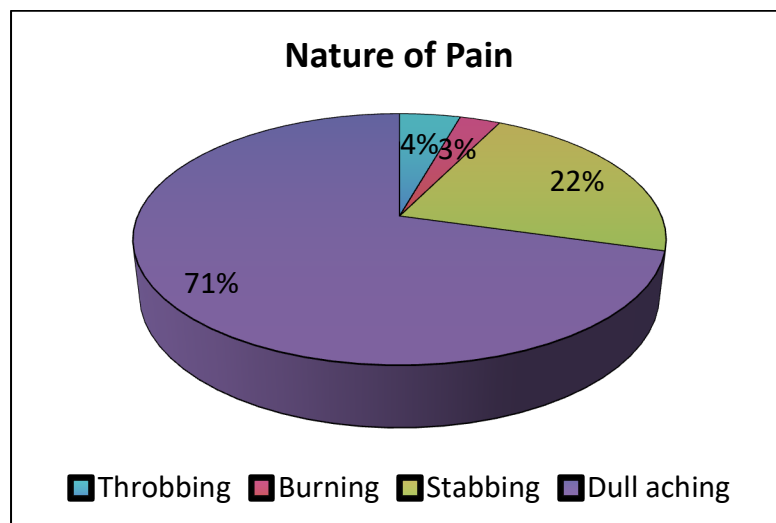


Figure 2: Patients with each Nature of pain

Discussion

Thoracic surgery often leads to well-documented complications such as ISP, which affect the overall health outcome of patients[20]. It has been postulated that ISP can be due musculoskeletal origin although its etiology is remains obscure[20]. Another theory suggests a musculoskeletal origin of isp where during surgery there are intraoperative positioning strain that lead to tension on the joint muscles of the shoulder[18, 22]. Prolonged thorac-

ic surgery characterized by unnatural postural positions may result into significant muscle strains as well as ligament stresses with subsequent serious pain in the shoulder after operation [12].

Also, another theory of common occurrence suggest that ISP is referred pain originating from the phrenic nerves or diaphragm. During thoracic surgery, the diaphragm is manipulated or retracted often which can cause irritation and injury thus leading to pain referred to as shoulder pain. This

hypothesis is supported by the fact that thoracic epidural analgesia, used in controlling incisional pain does not affect ISP implying an alternative pathway for pain transmission [5, 12, 14, 18].

Risk factors for ISP should be identified and be used as a guide towards prevention [23]. Age and pre-existing pathologies of the shoulder are important patient-related risk factors [16, 24]. Advanced age is associated with increased risk of developing ISP possibly due to reduced tissue elasticity and presence of degenerative disorders such as arthritis or rotator cuff tears. Also, it has been proven that there are gender disparities with some studies indicating that women may have more cases of ISP than men probably in relation to different perception of painful stimuli and physiological responses [21, 25].

Extensive retraction and long surgeries tend to strain the shoulder and related parts for longer periods leading to an increased chance of ISP occurring. Therefore, techniques that minimize tissue disruption and inflammation contribute greatly in reduction of ISP incidence. In this regard, less invasive surgical methods and careful handling of tissues during surgery may decrease the risk [2, 3, 20].

High-risk patients have to be identified through preoperative assessment such as screening for preexisting shoulder conditions, considering patient age as well as overall physical condition and planning interventions accordingly [4, 20]. Educating patients on possibilities of ISP and discussing pain management strategies before operation can also set realistic expectations thereby enhancing postoperative compliance [15].

Postoperatively, pain management requires a multimodal approach [6, 7]. Pharmacological treatments to manage ISP include NSAIDs, opioids, and muscle relaxants. Nonetheless, the efficiency of these medications differs in addition to causing different side effects. In addition, it would be useful if non-pharmacological approaches were considered alongside pharmacological methods [6, 8, 19]. This method is significant for protecting against pain as well as improving chances of recovery through decreasing shoulder pains that limit mobility thus reducing their ability and flexibility [9].

However, despite all these strategies being put into place, integrative medicine remains an important point whereby more research should be conducted on this particular issue [9, 16, 20]. Furthermore, future studies must concentrate on identifying biomarkers for ISP which can help in early diagnosis and targeted treatment for this disorder. Moreover, identifying novel analgesic techniques such as regional nerve blocks or advanced neuromodulation has potential for enhancing efficient pain control strategies too [1, 3]. It is therefore necessary to gain

insight into how exact mechanisms behind ISPs work through such research so that interventions may be made more precise hence effective at the end [1, 9, 10, 12, 17, 20, 24].

Conclusion

The study concluded that there was 56.67% of patients with ipsilateral shoulder pain (ISP) and it is most commonly associated with dull aching and is frequently localized to the anterior and superior parts of the shoulder. ISP is more prevalent in older patients with higher BMI and is significantly associated with epidural analgesia and thoracotomy procedures. In conclusion, the analysis of ipsilateral shoulder pain (ISP) among the patients reveals several important findings. The baseline characteristics indicate no significant gender differences in the occurrence of ISP, although patients with ISP tend to be slightly older and have a higher Body Mass Index (BMI) compared to those without ISP. The examination of age, BMI, and ASA scores shows that normal weight is the most prevalent BMI category among patients with ISP, with younger patients (20-30 years) being more likely to report ISP, though these differences are not statistically significant. Surgical factors also play a role, with thoracotomy being more common among ISP patients and epidural analgesia being significantly more frequent in this group. Notably, a significant number of ISP patients received epidural blocks below the T8 level. The duration of anesthesia and surgery times, along with positional times, did not show significant differences between those with and without ISP. The nature of ISP predominantly involves "dull aching" pain, followed by "stabbing" pain, with fewer patients experiencing "throbbing" or "burning" sensations. The pain is most frequently localized to the anterior and superior parts of the shoulder. These findings highlight the complexity of ISP, emphasizing the need for targeted approaches in managing and understanding this type of pain in clinical settings.

The clinical contribution of this study lies in its detailed characterization of ipsilateral shoulder pain (ISP), identifying key factors such as age, BMI, and specific surgical procedures (e.g., thoracotomy and epidural analgesia) that are associated with an increased incidence of ISP. By understanding the predominant nature and locations of pain, healthcare providers can develop more targeted pain management strategies, improve preoperative assessments, and tailor postoperative care to mitigate ISP. This study also highlights the need for vigilant monitoring and personalized interventions in patients at higher risk, potentially enhancing patient outcomes and quality of care.

References

1. A. Ohmori, H. Iranami, K. Fujii, A. Yamazaki, and Y. Doko, "Myofascial involvement of su-

- pra-and infraspinatus muscles contributes to ipsilateral shoulder pain after muscle-sparing thoracotomy and video-assisted thoracic surgery,” *Journal of Cardiothoracic and Vascular Anesthesia*, vol. 27, no. 6, pp. 1310–1314, 2013.
2. S. Sultanpuram, G. K. Alaparathi, S. K. Krishnakumar, and Z. C. Ottayil, “Physiotherapy practice patterns for management of patients undergoing thoracic surgeries in india: A survey,” *Surgery research and practice*, vol. 2016, no. 1, p. 9 717 489, 2016.
 3. G. Galvaing et al., “Impact of surgical positioning on the occurrence of postoperative ipsilateral shoulder pain after lung resection by video-assisted thoracoscopy: A randomized trial,” *Journal of Cardiothoracic and Vascular Anesthesia*, vol. 38, no.5, pp. 1190–1197, 20 24
 4. S. Saha, E. L. Brish, A. M. Lowry, and K. Boddu, “In select patients, ipsilateral post-thoracotomy shoulder pain relieved by suprascapular nerve block,” *American Journal of Therapeutics*, vol. 18, no. 4, pp. 309–312, 2011.
 5. S. Manzoor et al., “Post-thoracotomy ipsilateral shoulder pain: What should be preferred to optimize it-phrenic nerve infiltration or paracetamol infusion?” *Annals of Cardiac Anaesthesia*, vol. 22, no. 3, pp. 291–296, 2019.
 6. R. R. Richards et al., “A standardized method for the assessment of shoulder function,”
 7. *Journal of shoulder and elbow surgery*, vol. 3, no. 6, pp. 347–352, 1994.
 8. S. S. Panda, S. Agarwala, V. Bhatnagar, S. K. Kabra, A. Jayaswal, and A. S. Bhalla, “A survey of musculoskeletal and aesthetic abnormalities after thoracotomy in pediatric patients,” *Journal of Indian Association of Pediatric Surgeons*, vol. 18, no. 4, pp. 136– 142, 20 13.
 9. S. Meena, P. Saini, G. Rustagi, and G. Sharma, “Ipsilateral shoulder and elbow dislocation: A case report,” *Malaysian Orthopaedic Journal*, vol. 6, no. 1, p. 43, 2012.
 10. A. Mohapatra and P. Choudhury, “An unusual case of ipsilateral shoulder and elbow dislocation,” *Journal of Ayub Medical College Abbottabad-Pakistan*, vol. 33, no. 4, 2021.
 11. D. Khunt, H. Chalodiya, S. Kakadiya, V. H. Ramanandi, and A. Desai, “Impact of shoulder pain and disability on the quality of life among cerebrovascular accident patients of surat, gujarat,” *Environment*, vol. 64, pp. 9–99,
 12. S. Nayak, “A study on the effectiveness of shoulder pain and disability index (spadi) in indian population,” M.S. thesis, Rajiv Gandhi University of Health Sciences (India), 2005.
 13. B. Mandal et al., “Patient-reported shoulder morbidity and fatigue among the breast cancer survivors: An insight from a tertiary care cancer hospital,” *Clinical Cancer Investigation Journal*, vol. 10, no. 1, 2021.
 14. M. Sahu, D. Gnanaraj Solomon, S. J. Vijay, and J. C. Sudhahar, “Ergonomic evaluation of the risk factors causing pain in the upper part of the body among it professionals in india,” *Work*, vol. 67, no. 4, pp. 993–1005, 2020.
 15. T. R. Alagappan, S. N. Senthilkumar, D. P. Dhanani, R. H. Vashi, D. N. Barot, and M. N. Savani, “Recognition of central nervous system sensitization and its risk factors in patients with unilateral musculoskeletal shoulder pain,” *Physiotherapy-The Journal of Indian Association of Physiotherapists*, vol. 13, no. 2, pp. 102–108, 2019.
 16. G. K. Sahu, D. S. Meena, S. Saini, A. Aravindan, and P. K. Datta, “Comparison of two different volumes of ropivacaine used in nerve stimulator guided inter-scalene block for arthroscopic shoulder surgery—a randomized controlled trial,” *Anesthesia Essays and Researches*, vol. 12, no. 4, pp. 786–791, 2018.
 17. A. Hodge, I. L. Rapchuk, and U. Gurunathan, “Postoperative pain management and the incidence of ipsilateral shoulder pain after thoracic surgery at an australian tertiary-care hospital: A prospective audit,” *Journal of Cardiothoracic and Vascular Anesthesia*, vol. 35, no. 2, pp. 555–562, 2021.
 18. K. Gupta, M. Gupta, N. Sabharwal, B. Subramaniam, K. G. Belani, and V. Chan, “Ultrasound-guided anterior suprascapular nerve block versus interscalene brachial plexus block for arthroscopic shoulder surgery: A randomised controlled study,” *Indian Journal of Anaesthesia*, vol. 67, no. 7, pp. 595–602, 20 23.
 19. R. Anushree, D. Vasudevan, J. Simha, R. Magizhan, et al., “Kops award abstracts: Pain,” *Indian Journal of Anaesthesia*, vol. 64, no. Suppl 1, S35–S40, 2020.
 20. A. Agarwal et al., “Effect of minimally invasive pain intervention in frozen shoulder patients: A cross-sectional study,” *Anesthesia Essays and Researches*, vol. 14, no. 4, pp. 620–626, 2020.
 21. A. A. S. A. Sayed, L. S. Vijayakumar, A. Chatterjee, and R. S. Thota, “Incidence and risk factors of ipsilateral shoulder pain in patients after thoracic surgeries,” *Indian Journal of Anaesthesia*, vol. 67, no. Suppl 1, S53–S59, 2023.
 22. S. Ouerghi et al., “A prospective, randomised comparison of continuous paravertebral block and continuous intercostal nerve block for post-thoracotomy pain,” *Southern African Journal of Anaesthesia and Analgesia*, vol. 14, no. 6, pp. 19–23, 2008.
 23. A. Manjunath, D. Markus, E. Berlinberg, L. Kenny, E. Strauss, and M. Kingery, “Syn-ovi-

- al fluid biomarkers at the time of arthroscopy predict 5-year outcomes,” *Orthopaedic Journal of Sports Medicine*, vol. 8, no. 7 suppl6, 2325967120S00337, 2020.
24. H. Chalodiya, D. Khunt, S. Kakadiya, and V. H. Ramanandi, “Prevalence of shoulder pain and disability among cerebrovascular accident patients of surat city in gujarat state of india,” *Indian J Physiother Occup Ther*, vol. 14, no. 1, pp. 15–20, 2020.
25. S. A. Arslan, M. R. Hadian, G. Olyaei, S. Talebian, M. S. Yekaninejad, and M. A. Husain, “Comparative effect of driving side on low back pain due to repetitive ipsilateral rotation,” *Pakistan journal of medical sciences*, vol. 35, no. 4, p. 1018, 2019.
26. G. Yadav, M. P. Jiandani, A. Mehta, and A. Nabar, “Shoulder joint dysfunction in patients with cardiac device implantation,” *Int J Health Sci*, vol. 3, no. 6, 2019.